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# Comparison of Post–Operative Hydrothorax in Supra 12th Rib Versus Infra 12th Rib Access in Prone Mini Percutaneous Nephrolithotomy

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## ABSTRACT

***Objective:*** To determine the risk of post-operative hydrothorax in supra-12th rib versus infra-12th rib access in prone Mini Percutaneous Nephrolithotomy.

***Study Design:*** Quasi-experimental study.

***Place and Duration of Study:*** Armed Forces Institutes of Urology, Rawalpindi Pakistan from Jun to Dec 2022.

**Methodology:** In our study, 110 patients underwent assessment for indication of Percutaneous Nephrolithotomy, level of access, anatomy, site of puncture, incidence of hydrothorax, and requirement of closed-tube thoracostomy.

***Results:*** Of the 110 patients who underwent prone Percutaneous Nephrolithotomy, 55(50%) patients underwent infra 12th rib tract approach (Group-1), and the rest, 55(50%) underwent supra 12th rib tract approach (Group-2) depending upon the location of stones, anatomy of pelvicalyceal system and stone burden. Overall, 10(9.09%) patients developed post-Percutaneous Nephrolithotomy Hydrothorax; out of these ten patients, 8(14.5%) patients were approached from the supra 12th rib tract and the remaining 2(3.6%) patients were approached from the infra 12th rib tract (*p*-value=0.047).

***Conclusion:*** The study concludes that in prone Percutaneous Nephrolithotomy, infra-12th rib tract renal access is safer than supra-12th rib renal access regarding chest complications (Hydrothorax).

**Keywords:** Hydrothorax, Infra 12th rib percuteous nephrolithotomy, Supra 12th rib percuteous nephrolithotomy.

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## INTRODUCTION

Renal stone disease is one of the worldwide health problems which results in morbidity and commonly demands urological intervention.[1] The prevalence of Kidney stones is 8.8% in the United States; it affects more men than women (10.6% versus 7.1%). There are several risk factors, including renal and ureteral anatomic abnormalities, positive family history, previous history of stones, and older age groups.[2] The scientific research of humans have always tried to make smart attempts to remove kidney stones ranging from huge instruments to exceptionally ultra-modern and minute endoscopic intruments.[3] There are different treatment options for renal stones, including observation expecting spontaneous passage, extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), and retrograde intrarenal surgery (RIRS) using flexible ureterorenoscope. The current standard treatment for large renal stones more than 2cm not responding to ESWL is PCNL.[4]

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In the current era, minimally invasive surgical procedures utilizing new advanced instruments and surgical techniques have gently replaced open surgery for treating large, complex urological stones.[5] It is crucial for the success of PCNL to use an appropriate calyx to access the kidney's collecting system to approach the stone.6 As PCNL surgical technique is developing day by day and becoming more minimally invasive simultaneously, its complications, such as adjacent organ injury, specifically pleural injury, e.g. (Hydrothorax, pneumothorax, hydropneumothorax) are also increasing.[6] In many studies, it is reported that supracostal access for PCNL is more advantageous than infracostal access.[7]

One of the most important advantages claimed is the shortest distance and most direct tract in PCNL; however, chest complications are more common. With good surgical skills and awareness of the limitations of infracostal access, urologists are attempting the supracostal approach; whether a supracostal or infracostal approach is better remains controversial. The objective of our study was to compare the post-operative chest complication in supra 12th rib and infra 12th rib access in mini-prone PCNL.

## METHODOLOGY

The quasi experimental study was conducted at Armed Forces Institute of Urology Rawalpindi, Pakistan from June to December 2022 after approval by Hospital Ethical Committee (Letter no. Trg–1/ IRB/2022/010). The sample size was calculated by WHO Calculator with reference parameters for infra 12th rib Prone PCNL hydrothorax as 1.4% (Group–1) and for supra 12th rib prone PCNL hydrothorax as 15.3% (Group–2).[8]

**Inclusion Criteria:** Adult patients of either gender, aged 18-70 years, who underwent elective prone PCNL with the stone size of more than 2cm and no active urinary tract infection, were included.

**Exclusion Criteria:** Patients with coagulopathy, pregnancy, active urinary tract infection, obesity, and COPD were excluded.

Fifty-five patients underwent Infra 12th rib tract prone PCNL, and the remaining 55 underwent supra 12th rib tract prone PCNL depending on the following factors, including the location of stones, anatomy of pelvicalyceal system and stone burden. All patients were pre-operatively assessed by a consultant urologist, considering inclusion and exclusion criteria. All patients were assessed by an anaesthetist using the ASA classification system. All PCNLs were performed under general anaesthesia in a prone position using fluoroscopic guidance. Ureteric Stents were placed in the ureters after general anaesthesia with the help of a cystoscope; after confirming the position of the ureteric stents by using a fluoroscope position of the patients were changed to prone, diluted contrast was pushed into the ureteric Catheter into the calyceal system by using fluoroscopy 12th rib was marked followed by supra or infra 12th rib renal access was chosen 18 Fr spinal or Chiba needle was used to puncture the system under the guidance of fluoroscope, the tract was dilated with fascial and metallic dilators. While doing the puncture anatomy of the pelvicalyceal system, the location of the stone and stone burden were the primary considerations. The puncture was done using bull's eye, gradual descent, or triangulation technique. Stone was fragmented by pneumatic lithotripsy in both groups (Figure). Patients who underwent infra 12th rib tract approach were included in Group-1, and Group-2 patients underwent supra 12th rib tract approach. Per-operatively, clearance was confirmed with the help of direct nephroscopic vision and fluoroscopic guidance.

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. Quantitative variables with normal distribution were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value of ≤0.05 was set as the cut-off value for significance.

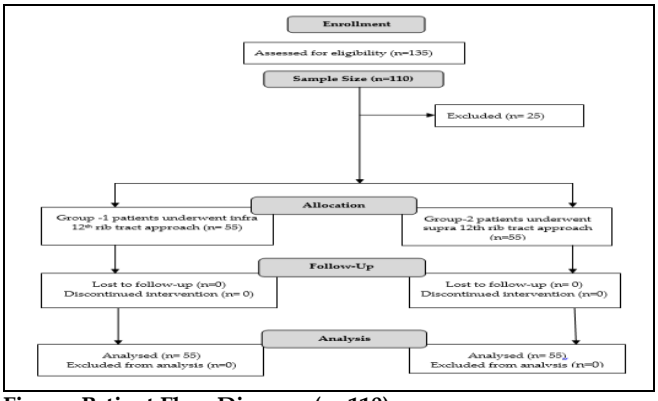


**Figure: Patient Flow Diagram (n=110)**

## RESULTS

Out of 110 patients, all individuals were randomly divided into two equal groups of 55 each. The minimum age of the recruited individual was 18 years, while the maximum age observed in the study was 67 years, with a Mean age of 36.67+12.05. The mean age in Group-1 was 35.29±12.07 years, while the mean age in Group-2 was 38.05±11.98 years (*p*-value 0.231). In our study group, 60(54.5%) were males, while 50(45.5 %) were females.A total of 3(2.7%) males developed hydrothorax compared to 7(6.3%) females with an insignificant *p*-value of 0.12 Table- I. Group-1 revealed a 1.8 % rate of development of hydrothorax as compared to Group-2, which was 7.2 %. The groups had a statistically significant difference in terms of frequency of development of hydrothorax with *p*-value of 0.047 (Table–II).

**Table - I: Frequency of Hydrothorax in Male and Female Patients (n=110)**

| | Gender | | *p*-value |
|---|---|---|---|
| | Male Patients n=60 n(%) | Female Patients n=50 n(%) | |
| YES | 3(5%) | 7(14%) | 0.12 |
| NO | 57(95%) | 43(86%) | |
| Total | 60(100%) | 50(100%) | |

**Table - II: Frequency of Hydrothorax in Supra 12th Rib track and infra 12th Rib track access Study Groups (n=110)**

| Hydrothorax | Study Groups | | *p*-value |
|---|---|---|---|
| | Supra 12th Rib Track Access n(%) n = 55 | Infra 12th Rib Track Access n(%) n = 55 | |
| Yes | 8(14.5%) | 2(3.6%) | 0.047 |
| NO | 47(85.5%) | 53(96.36%) | |
| Total | 55(100%) | 55(100%) | |

## DISCUSSION

In the field of urology, the use of minimally invasive techniques has evolved dramatically despite the continued high prevalence and recurrence of urinary tract stone disease. In the last 30 years, minimally invasive techniques for treating renal stones have steadily improved, and new techniques are being developed with the help of a combination of instruments and technology.[9] Percutaneous nephrolithotomy (PCNL) is a minimally invasive procedure considered as first-line treatment for complex renal calculi, claiming one of the best stone clears along with some severe complications, including chest complications.10 In Renal calculi >2cm, now PCNL is considered the standard treatment option.[11]

In different studies, pleural injury ranges from 0.3% to 1% in PCNL. The main reason is that the diaphragm and pleura are principally adjacent to the upper pole of the kidney; the injury during percutaneous access is more common in supra 12th rib renal access than infra 12th rib renal access.[12] When PCNL was started in the initial days, urologists dither to use supra 12th rib access, so commonly, the majority of the urologists chose to use infra 12th rib access, disadvantages of infra 12th rib access results in a large bulk of residual stones because stones cannot be adequately approached and increased bleeding due to application of extra torque over the nephroscope in the kidney.[13] It is now considered by the most urologist that supra 12th rib access is considered as safe as infra 12th rib in terms of pleural injury, bleeding, adjacent visceral injury and stone clearance.[14]

Ashok Kumar *et al*. published a study in Nepal to assess pleural injury in PCNL. According to that study, a total number of 101 patients underwent PCNL. Only three patients who underwent supracostal access (2.97%) had a pleural injury. In our study, overall, 10(11%) patients developed post-PCNL Hydrothorax; out of these 10 patients, 8(7.2%) patients were approached from the supra 12th rib tract, so according to our study, the supra 12th rib tract had an increased rate of Hydrothorax complications so this study contradict to our study.[15]

Another study was published in Thailand by Treewattanakul *et al*. according to that study, out of 325 patients who underwent supra 12th rib track access, only 42(13.6%) patients had hydrothorax, in the same way as our study, 10(11%) patients who developed post-PCNL hydrothorax out of them 8(7.2%) patients who had supra12th rib tract access had hydrothorax this study supports our study that supra 12th tract access in PCNL had more chances then infra 12th rib access.[16]

A study was conducted in Thailand by Lojanpiwat *et al*. according to that study, 464 patients underwent PCNL. Of them, 170 patients had supra 12th rib access, 294 patients had infra 12th rib access, and 26 (15.3%) patients had supra 12th rib access had hydrothorax. In infra 12th rib access, only 4(1.4%) patients had hydrothorax. In the same way, our study had the same result in our study: out of a total of 110 patients, 10(11%) patients had hydrothorax out of 8(7.2%) patients who underwent supra 12th rib access.[8]

Study conducted in Nepal according to that study (2.97%) of patients had pleural injuries by supra 12th Rib access. This study contradicts our study as in our study (7.2%), patients underwent supra 12th rib access.[17] Another Study was conducted by Guzel *et al*. in Canada; according to that study, patients who underwent supra 12th Rib renal access had 19.1% chest complications. This Study supports our study that there are increased chances of thoracic injury in patients in which supra 12 rib renal access is used in PCNL.[18]

## CONCLUSION

In prone mini PCNL supra 12th rib renal access, there is a higher incidence of hydrothorax in comparison to infra 12th rib renal access. During pre-operative planning, the patient should be counselled about the risk of hydrothorax. Prompt diagnosis and early management are the keys to avoiding the life-threatening complications of pneumothorax, haemothorax, and hydrothorax.

**Conflict of Interest:** None.

**Authors Contribution**

Following authors have made substantial contributions to the manuscript as under:

SK & SR: Conception, drafting the manuscript, approval of the final version to be published.

WAR & AN: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MAK & HA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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